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WATER POLLUTION CONTROL POLICY

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Since the end of World War II, there has been much public interest in water pollution control and considerable activity on the part of Federal and State governments in this field. A number of States have new or extensively amended laws. Interstate compacts regulating the pollution of interstate streams have recently been ratified in the New England and Ohio River areas. Also, the International Joint Commission, established by treaty between the United States and Canada, has shown renewed interest in the pollution of the boundary waters between the two countries.

Historically, water pollution control has been associated with the protection of public health. While public health considerations remain of highest importance, it has been recognized that other phases of the problem deserve emphasis. There has been no lessening in concern over the health aspects, but there has been a definite trend in the direction of considering the effects of pollution on all water uses. Water pollution control activities are still centered in the health departments of 27 States and territories. Water pollution control boards or commissions have been established within the State health departments of eight States. Nine States have boards or commissions on which the health department is represented, and in these States the health department acts as the executive and technical agency. Separate water pollution control agencies having State health department representation have been established in nine States. All State organizations have recognized the continuing interest and responsibility of the State health department in the field of water pollution control. There are good reasons for maintaining a high degree of health department interest and participation in pollution control. State health departments have had long experience in this field, and their contributions to it are well known. Water pollution produces many objectionable effects but health aspects are still of major concern.

The Federal Government, through the Congress, has asserted only limited control over water pollution. One section of the Navigation Act of 1899, which is in force today, prohibits the deposit of all kinds of refuse, other than that flowing from streets and sewers in a liquid state, into navigable waters and their tributaries. Much Congressional interest in the health aspects of water pollution was evidenced by the introduction during the 1890-1910 period of bills calling for investigation of this phase of the problem. Specific Congressional authority for water pollution investigations was provided as a part of the revised U. S. Public Health Service Act of 1912. This led to extensive water pollution research by the Public Health Service, the results of which are well known. Following World War I, the pollution of coastal waters by oil apparently reached critical proportions and considerable Congressional attention was given to the problem during the early 1920's. Many bills were introduced and, after extensive hearings, the Oil Pollution Act of 1924 was enacted.

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The first evidence of Federal legislative attempts to develop a comprehensive approach to the water pollution problem appeared in the thirties. Several bills similar in many respects to the present Water Pollution Control Act received favorable consideration by the Congress but for various reasons never were enacted into law. It was not until 1948 that bills introduced in both House and Senate were enacted into Public Law 845 (80th Congress), the Water Pollution Control Act.

Certain policies were defined in the Water Pollution Control Act of 1948, others are implied, and others have been developed by the Public Health Service as required for program operation. Major policies in connection with the national water pollution control program are as follows: (1)

(a) State Responsibility - With respect to State responsibility, the policy is specified in Section 1 of the Act. It is to recognize, preserve and protect the responsibilities and rights of the States in controlling pollution. Recognition of State rights and responsibilities has been a traditional policy of the Public Health Service.

(b) Federal Responsibility - The Act limits the responsibility of the Federal Government in the field of water pollution control. The enforcement provisions of the Act are restricted to cases of interstate pollution, and enforcement procedures are specified. Policy has been to define the areas in which interstate pollution is occurring and to leave initial responsibility for enforcement with the States.

(c) Local Responsibility - Policy in this respect holds that the cities and industries creating pollution are responsible for its abatement.

(d) Interstate Co-operation - Ineffective pollution control in one State increases the difficulty of effective control in another State in the same basin. The need for co-ordinated action on interstate streams was recognized, and there was included in the Water Pollution Control Act a provision directing the Surgeon General of the Public Health Service to encourage compacts between the States.

(e) Industry Co-operation - Public Health Service policy has been to recognize industry as a key member of the team engaged in solving water pollution problems. To implement this policy, the National Technical Task Committee on Industrial Wastes was formed. The membership of this Committee represents all of the major waste-producing industries.

(f) Research - The policy under the Water Pollution Control Act has been to expand research and investigation activities on the part of the Public Health Service. One section of the Act authorized the construction of the Environmental Health Center's new research facilities at Cincinnati. At the same time the policy has been to encourage research and investigations on the part of industries and State and local agencies. Section Eight of the Act authorized grants to State and interstate water pollution control agencies for the conduct of investigations, research and surveys. While there is continuing authorization for such grants, no grant funds were appropriated during the current fiscal year.

(g) Water Resources Programs - Policy established in connection with water resources development programs has held that water pollution control is an integral part of water resources development programs and that water pollution aspects should be considered in the initial planning stages.

Until fairly recently, major emphasis in the field of water pollution control was placed on the problem of sewage pollution, initially because of the relation to water-borne enteric disease and later because of the effects of organic pollution on streams and aquatic life. Some measure of the current interest in sewage pollution abatement is given by the average expenditure (2) based on contract awards for public sewage treatment plant and interceptor construction during the period 1948-1952. This average expenditure was $173,000,000 annually (1950 dollars). The factor of obsolescence is apparently an important element in the sewage treatment picture. Of the $137,000,000 expended in 1952 on 515 projects, 43 per cent of the total expenditures, and 39 per cent of the projects, covered additions, enlargements or replacements to existing facilities. (2)

As the American economy has become increasingly industrialized, the contribution to our streams of water-borne industrial wastes has grown in importance. Industrial production in the United States has increased about sixfold in the last 50 years, and the outlook is for substantial further increase. (2)

Rough indications of the increase of potential pollution contribution may be obtained from estimates of water requirements. Municipal water usage is at present estimated to be about 17 billion gallons daily and is expected to increase by 50 per cent by 1975. In the same period it is estimated that direct industrial water use will increase by 170 per cent (80 to 215 billion gallons daily). (3) The problem of water pollution control will be one of growing importance.

Water pollution is of such a complex nature that it is probably futile to attempt to frame a definition that would apply to every existing or conceivable situation. However, when water pollution is considered, it is usually in terms of at least these elements:

(a) A source of waste.
(b) Unreasonable impairment of receiving water quality.
(c) Interference with water use.

Water quality is judged on the basis of concentration. With certain exceptions, concentration of a pollutant is a function of receiving water volume, so whether or not pollution results from a waste discharge generally depends on the availability of dilution water. It is nearly impossible to make use of water without in some way impairing its quality. Unreasonable impairment occurs when the waste discharge interferes with the subsequent beneficial use of the water. Pollution abatement is often the key to water re-use.

There is general agreement with the statement that water pollution should not be allowed to interfere with water uses important to an area. This is a simple policy statement, but it is subject to many technical and administrative uncertainties. There is also general agreement with the statement that the use of a natural watercourse for the disposal of liquid wastes is as necessary and legitimate as its use for any other purpose, subject to the limitation of noninterference with other reasonable uses. (4) The thesis that most receiving waters have some capacity to assimilate wastes and that this capacity should be utilized in the interests of economy, is a generally accepted one. Practical application of these concepts poses many difficulties. Determination of assimilative capacity may prove to be a formidable task. Probably there is more to be learned about this aspect of water pollution than has been learned. For the water pollution control agency, administrative problems associated with the utilization of assimilative capacity may be quite

difficult especially when there are multiple sources of pollution. No one has exclusive rights to the assimilative capacity of a stream. The criterion for its use should be the public interest, and this will require allocation of the stream's capacity to handle wastes among those who need to use it. No one can specify an ideal policy for accomplishing allocation. Camp (5) and Agar (6) have discussed this problem and the latter indicated a possible solution to a hypothetical problem. It is fairly certain that allocations can not remain static. Change is a characteristic of water pollution problems. Industries expand, cities grow, and new sources of pollution have to be considered. This will probably mean additional treatment or other corrective measures for existing sources of pollution, a possibility that should be kept in mind when initial corrective measures are taken. With a multiplicity of factors affecting allocation, it seems obvious that case-by-case study, giving full consideration to all related elements, is the only reasonable policy to pursue. Closely associated with assimilative capacity is the somewhat controversial subject of water quality standards.

Terms frequently used in recently adopted legislation and regulations include: "objectives," "criteria" and "standards." "Objective," where used, appears intended to denote the goals of program administration. The word "objective" suggests a desirable end to be reached, and can be interpreted as an eventual but not necessarily an immediate accomplishment. Any realistic water pollution control policy must recognize this basic "fact of life" - that pollution cannot be abated immediately. It is frequently necessary to accept less than an entirely satisfactory abatement program pending solution of technical and financial problems. In contrast to "objective," the word "standard" has had a connotation of a rigid legal requirement. There is also the impression that the word "standard" carries with it a requirement for immediate compliance. "Criteria" denote a method of measurement or means of forming a judgment.

In regard to the so-called "standards" of water quality adopted by many of the States, the actual rigidity of these "standards" is probably much less than the word "standard" may suggest. Probably "standards" are more of the nature of "objectives" in most instances. In connection with the large numbers of substances included in such terms as "toxic wastes," "dissolved minerals," "deleterious substances," "colored wastes," "heated liquids," etc., general statements only are usually included in the "standards." These may be regarded in effect as program "objectives." The New York State "standards" for instance, include a series of statements which say, in effect, that such classes of materials shall not be present in amounts sufficient to interfere with the water uses for which the various classifications of the waters are intended.

In Ohio, "objectives" of water quality have been used as an administrative device. (7) In this instance they are construed as criteria on which judgment may be based in determining the quality of effluent discharges in individual cases. This is similar to the practice followed by the International Joint Commission in which the announcement of general water quality "objectives" was supplemented by tentative specific "objectives" and the probable effluent requirements which would be associated with them. (8)

The guiding policy of the Ohio River Compact is "that pollution by sewage or industrial wastes originating within a signatory State shall not injuriously affect the various uses of the interstate waters." The Compact agreement itself specifies a minimum degree of treatment of sewage discharged to the Ohio River and certain of its tributaries. The Commission has adopted

water quality "objectives," including "objectives for bacterial content of waters to be used as water supply sources or for recreational purposes." The approach of the Commission has appeared to be the study of individual cases or areas and the subsequent promulgation, after public hearing, of effluent requirements designed in each case to meet the appropriate "objective" and thus prevent injury to the various water uses.

Recent legislation in several States appears to provide generally for the "case-by-case" administration of water pollution control problems. Apparently the intent is that administrative decision be guided in individual cases by the general legislative objectives and available technical criteria of water quality. The outstanding example of this approach is provided by California. The California control program is based on case-by-case handling of pollution problems by the regional boards. For the advice of the regional boards, the California State Board has undertaken the compilation and analysis of available technical and legal data on water quality. This excellent report, entitled "Water Quality Criteria," (9) has recently been published and sanitary engineers everywhere are indebted to California for a valuable reference work. From a policy standpoint, it is interesting to note that the first of the recommendations contained in the letter of transmittal of this report on Water Quality Criteria" is as follows:

"That the Water Pollution Control Boards make no attempt to establish tabulations of water-quality standards and that each problem of water pollution be studied and evaluated separately in the light of local conditions, the many variable factors that affect pollution and the data contained in this compendium of criteria." (9)

Also of great interest from a policy standpoint are certain unusual features of the new California legislation. (10) Under California law, water pollution control is decentralized into nine regions. Regional boards are responsible for prescribing regulations for waste discharges, obtaining co-ordinated action in controlling pollution, enforcing orders for pollution abatement, and formulating long-range policies with respect to water pollution control. Regional boards may not specify the methods of abating pollution. They can specify the results to be achieved but not the means of achieving them. Provision is also made in the California law for the separation of fact-finding from enforcement. The California statutes also make a distinction between public health and the conservation aspects of water pollution by defining the terms "contamination" and "pollution." "Contamination is water quality impairment by sewage or industrial waste which causes a public health hazard. "Pollution" adversely and unreasonably impairs the beneficial use of water. (10)

Some general remarks about the "standards," "objectives," and "criteria" in use are appropriate to this discussion. The disadvantages of arbitrary application of effluent standards have been discussed by Agar (5) and others. The most important disadvantage is the lack of correlation with actual stream conditions and the needs for various water uses. Undercorrection may result in some cases and overcorrection in others. Current policy by many regulatory agencies seems to reflect this attitude, and the trend has been in the direction of establishing "objectives" of receiving water quality. In general, such a procedure is considered advantageous inasmuch as attention is focused on the stream itself, which is the thing to be protected. While the International Joint Commission, the Ohio River Valley Water Sanitation Commission, and others, have made use of effluent "standards" these effluent requirements

have been made subsidiary to the "objectives" of receiving water quality for the existing or anticipated water uses in the respective areas.

There are numerous technical problems associated with the establishment of receiving water quality objectives. In establishing a quality "objective," it is necessary to recognize an initial period of mixing of the waste with the receiving water. (Figure 1 illustrates phenol concentration variation across a wide stream). Special provisions may be required to insure mixing in some instances. Also to be considered is the problem of substances which either do not mix or may not remain dispersed, such as oil and settleable solids.

In specifying an "objective," some consideration should also be given to sampling specifications and whether or not the results of a series of samples are to be averaged and if so what "average" is to be used. Some "objectives" have recognized the inherent variability of water quality and specify an average figure but permit some departure from the average and a limiting frequency of occurrence. Critical low flows pose another problem. Use of the term "critical low flow" without specifying whether a daily, weekly or monthly average, and without giving any idea as to the probable period of recurrence, leads to confusion. In selecting a stream flow on which to base corrective measures, consequences of occasional failure to reach the desired "objective" need to be considered. Less than complete achievement of the objective may be tolerated in some cases, and this may mean substantial savings in pollution abatement costs. Temperature of the receiving water is another factor that should be considered in connection with critical flows. Where oxygen relations are the principal problem, a low flow during the winter period will generally have less significance than one occurring during the summer. In addition to the problems already mentioned, there are those associated with the measurement of quality characteristics. The Board of Technical Advisers to the International Joint Commission found it necessary to specify certain analytical methods in connection with the establishment of objectives. Hedgepeth (11) has pointed out how variation in the results of the chlorine demand test, depending on the method used, could make a very large difference in charges for industrial waste treatment.

Some of the long established and apparently fairly simple criteria of water quality present complex problems of sampling and measurement. For example the dissolved oxygen content of natural waters may be subject to large diurnal fluctuations due to photosynthesis. (Figure 2). Probably the erratic results obtained in some stream surveys are the result of this factor. What is sorely needed is a continuous dissolved oxygen recording device.

Bacteriological techniques have been well standarized, and average, log-average, median, maximum and minimum coliform results are reported with confidence, and fairly important decisions may be based upon them. However, it should be remembered in dealing with quantitative bacteriological results obtained by the multiple fermentation tube method with no more than three tubes in each dilution, that the estimates of bacterial density are not precise and that the difference between a result of 230 coliforms per 100 ml and one of 2300 may be more apparent than real. A more precise means of measuring bacterial numbers is needed. The membrane filter technique shows promise of improving the accuracy of bacterial density measurements.

Another water quality problem is that of limiting requirements for various water uses. Irrigation is the largest user of fresh water resources in the United States, but what its sanitary quality should be is still a matter of conjecture. Standards for safe bathing water vary widely and there is some

evidence to indicate that the more stringent ones should be relaxed somewhat. (12) Probably other criteria of water quality need to be examined critically. The more one examines the problem of water quality "standards" or "objectives," the more apparent becomes the difficulty of establishing exact values having general applicability. However, statements of program "objectives" which set forth the general considerations involved in the administration of water pollution control programs can serve a very useful purpose. Specific "objectives" once established should not necessarily remain fixed. They should be scrutinized frequently in the light of new knowledge and changing water uses. Such scrutiny should be the policy of all having an interest in the field of water pollution control. Flexibility should be, and to a great extent is, a prominent characteristic of water pollution control administrative policy. The necessity for such flexibility should be apparent in view of the complexities of waste characteristics, aquatic biology, the reactions involving pollutional materials, the variations in dilution water available, and the difficulties often met with in making decisions involving the equities of various water uses.

The gaps in current technical knowledge relating to the control of water pollution are often obvious to control agencies, cities and industries. For instance, aside from the ignorance of economical methods for satisfactorily reducing the pollutional effects of certain industrial wastes, we may lack suitable analytical procedures for the determination of some important polluting substances and their effects. When faced with the problem of analyzing certain complex industrial wastes, we may find ourselves in a chemical jungle. New or greatly modified yardsticks of waste strength and behavior may have to be developed to meet a particular situation. We know little about the rate of biological metabolism of many polluting substances, and in the absence of such knowledge are not able to take full advantage of the self-purification which occurs in the receiving waters. Obviously industry itself must assume a big share of the load in the vast amount of research and development work required in the solution of these problems.

Sewage treatment problems have been exhaustively studied and there is certainly reason to be proud of the progress made in this field of water pollution control. Efficient sewage treatment methods are known, and efficient plants are being designed and built every day. However, much remains to be done and we should be alert to the possibilities for still greater efficiency and economy. Even a small percentage saving would be welcome and make the task of raising money for their installation easier. There are some important gaps in our knowledge of the health aspects of sewage disposal. For instance, knowledge of the role of the enviroment in the transmission of virus diesases is meager. Little is known as to the effectiveness of existing methods of water purification and sewage treatment in destroying virus material and equally little about the persistence and transportation of viruses in polluted water. The occurrence, activity and fate of fungi in water are largely unexplored fields. There is some reason to believe that fungi are important factors in the formation of taste and odor producing substances. (13) Little is known regarding the possible spread of fungus diseases through surface waters or about the survival of pathogenic fungi in polluted waters.

Summary

Certain major policy and related points are summarized as follows:

(1) Water pollution, historically associated mainly with public health, is now being viewed on a much broader basis. Over-all water use as well as health problems are receiving consideration. Legislation and regulatory agency policies have been or are being adjusted accordingly.

(2) There is general recognition of the fact that one of the most important uses of watercourses is for the disposal of water-borne wastes, subject to the limitation that use for this purpose should not interfere unreasonably with other legitimate water uses. There is also general agreement that in the interest of economy the available assimilative capacity of receiving waters should be utilized to as great an extent as possible.

(3) The goal of pollution control progress is the restoration or maintenance of satisfactory quality in the receiving waters. Evidence of recognition of this principle is afforded by the trend toward more emphasis on the quality of receiving waters as the governing factor in program administration.

(4) Pollution abatement is a matter of local responsibility. This does not mean that uncorrelated individual effort is best. Often co-operative action, especially on the part of industries and municipalities, can lead to the most economical solutions to abatement problems. Cities and satellite communities will generally find that co-operation is advantageous. A major part of regulatory agency activity should be directed toward creating an awareness of local responsibility and the need for local action and co-operation to carry on progressive and just programs.

(5) Industry is recognized as an essential member of the water pollution control team. There is ample evidence of the general willingness of industry to co-operate in developing solutions to complex waste disposal problems and to recognize waste handling as a part of the over-all problem of production. Industry is in the best position to contribute and can and does contribute to the solution of industrial waste problems. In turn, industry expects co-operation from the water pollution control agency in the form of sould advice and realistic requirements.

(6) Water pollution control agencies are faced with a heavy responsibility in administering control activities. They are expected to carry on progressive and just programs. They need support commensurate with the magnitude of their task. Realistic programs require realistic appropriations.

(7) Research and development on a broad front are obvious necessities. Much has been learned about water pollution in the last fifty years but much more fundamental knowledge is needed. Research in physics, chemistry and biology, supplemented by engineering development, can supply the needed answers if opportunity for such research and development is provided. To a great extent, future progress will be dependent on these answers. Sanitary engineers cannot "go it alone" in the water pollution field. A close working relationship with the chemist, the physicist and the biologist is not only desirable, it is a necessity.

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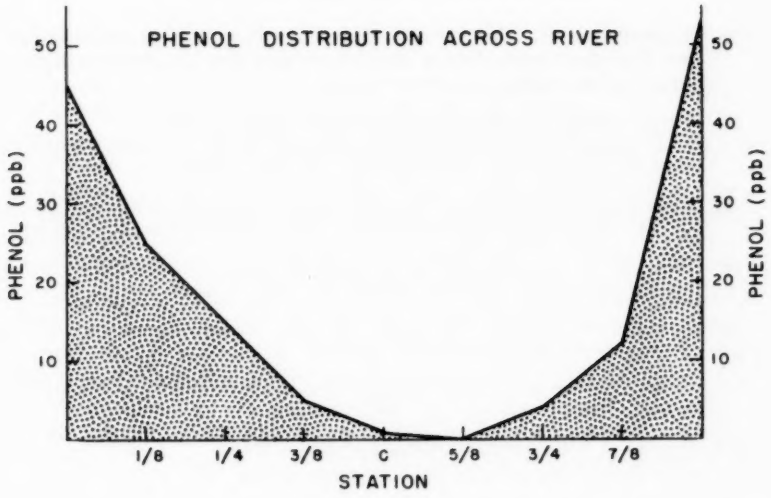

FIGURE 1

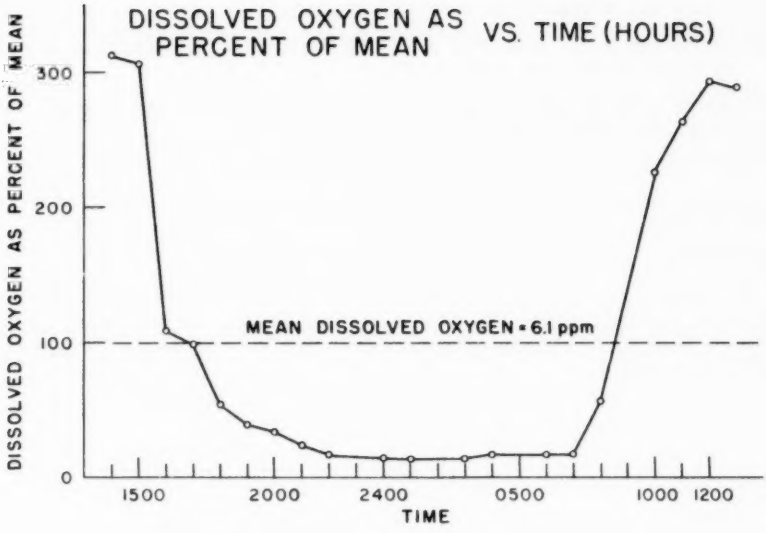

FIGURE 2